DOCUMENT RESUME

ED 259 702 IR 011 734

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TITLE Computer Assisted Instruction. A Report to the Board.
INSTITUTION Greater Albany Public School District No. 8J, Oreg.
PUB DATE May 85
NOTE 38p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Attitudes; *Computer Assisted Instruction; Computers; Course Evaluation; Courseware; Elementary Education; *Evaluation Methods; Instructional Design; Instructional Development; *Instructional Improvement; Instructional Material Evaluation; *Mathematics Achievement; *Mathematics Education; Teaching Methods
IDENTIFIERS Oregon (Albany)

ABSTRACT

This report presents the findings of an evaluation conducted in the Greater Albany Public School System 8J (Oregon) to determine the effects of computer assisted instruction (CAI) in mathematics as delivered by the WICAT System 300 at the Periwinkle Elementary School. Evaluation activities were designed and conducted to determine whether the participants felt that CAI improved elementary school children's math achievement, and to explore student, parent, and staff attitudes towared the utilization of this instructional technique. The report itself consists of an executive summary and five sections: (1) an introduction; (2) a description of the existing math curriculum in the elementary school; (3) the evaluation design for measuring the changes in student achievement; (4) the results of the study; and (5) highlights of the significant findings. Major findings indicated that achievement scores improved significantly--with the most dramatic improvements among students in the second grade-- and that students, parents, and staff gave high ratings to CAI. (JB)

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GREATER ALBANY PUBLIC SCHOOL DISTRICT 8J

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COMPUTER ASSISTED INSTRUCTION

A Report To The Board

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MAY 1985

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IR011734

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EXECUTIVE SUMMARY

This report presents the findings of an evaluation of computer assisted instruction in mathematics as delivered by the WICAT System 300 installed at Periwinkle Elementary School in the Greater Albany Public School District 8J.

Evaluation activities were designed and conducted to answer two questions: (1) Does computer assisted instruction improve elementary school children's math achievement? (2) How do students, parents and staff feel about computer assisted instruction?

The primary findings of the evaluation were:

* Achievement scores in math computation and math total (computation and concepts/applications combined), when compared to a national norm, improved significantly in three of four student grade-level groups during the first year of computer assisted instruction. Math computation and math total scores in the fourth grade-level group remained essentially constant.

* The most dramatic improvement in mathematics achievement was among primary students who were in the 2nd grade in 1984-85. Expressed as a "growth percentage," these students had a 29 percent growth in math computation scores. This compares to 9 percent and 15 percent increases in the other two grade-level groups that had significant gains.

* Achievement scores in math concepts/applications, when compared to a national norm, remained essentially constant for all four grade-level groups through the first year of computer assisted instruction.

* There were no significant differences between the number of boys and girls whose math achievement scores either improved or dropped. Both sexes shared similarly in the mathematics achievement gains associated with the first year of computer assisted instruction.

* Students gave high ratings to computer assisted instruction both in 1984 before using WICAT and in 1985 after a year of experience on the system. Primary students modified their ratings downward after using the system; intermediate students remained the same after using the system.

* Parents and staff, while acknowledging the cost of implementing the program, gave favorable ratings to the importance and productivity of computer assisted instruction, both in 1984 before WICAT was operational and in 1985 after a year of experience with the system.

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I. INTRODUCTION

This report, Computer Assisted Instruction: A Report to the Board, consists of an Executive Summary and five sections. Section 1 introduces the contents of the report. Section 2 describes the math program at Periwinkle and includes information about the WICAT System 300 and the regular math curriculum. Section 3 describes the evaluation design that was planned and implemented to examine the changes in student achievement, student attitude, staff attitude and parent attitude associated with the introduction of computer assisted instruction in the math program. Section 4 presents the results of the study in considerable detail. Section 5 highlights and briefly discusses some of the significant findings of the evaluation.

II. OVERVIEW OF WICAT COMPUTER SYSTEM *

The WICAT (World Institute of Computer Assisted Teaching) Computer System was installed at Periwinkle Elementary School in the Spring of 1984. Periwinkle Elementary, located in a predominately white, middle class, southeast Albany neighborhood, serves approximately 370 students in kindergarten through fifth grades. The school is staffed with sixteen regular classroom teachers, a music specialist, a resource room teacher, a librarian, a part-time counselor and other support staff.

The computer system is located in a regular classroom that has been modified to house WICAT. Student terminals are located in study carrels. These carrels are located around the perimeter of the room on three sides and in an island in the center of the room. The management terminal is also located in this center island. The computer, which serves all student terminals, is located in a small built-in room within the classroom. Because of the heat generated by the computer the room is air-conditioned.

The WICAT System 300, developed by WICAT Systems, Inc., supports thirty student workstations with graphics, animation and audio capabilities. Each workstation consists of a green monitor, a keyboard and earphones. The System 300 has a MC68000 processor supported by forty-two co-processors. The System was installed with an 84 Mbyte hard disk that has been upgraded to 474 Mbyte with a tape drive for backup. Peripheral equipment includes a modem and printer. The total cost of the hardware and facility modifications was approximately $120,000. In addition to the initial costs there is a yearly maintenance contract and software lease cost of $18,000.

System courseware covers the three basics - reading, writing and arithmetic. In addition, instructors can also create their own courses and lessons with the adaptable WISE courseware development system. WICAT also uses a management system that allows student information to be entered, students to be scheduled into each of the curriculum areas and student progress to be tracked. Because of the implementation timeline and the availability of

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* This section, "Overview of WICAT Computer System," was written by Elaine Wells, computer curriculum coordinator for the Greater Albany School District.

courseware, arithmetic/math was the only courseware that students used any length of time. Thus, this evaluation only addresses arithmetic. Other courseware is now being implemented and evaluations will be available in another year.

The WICAT Math curriculum is organized around seven subject areas: addition, decimals, division, fractions, multiplication, subtraction and whole numbers. Each subject area is divided into units that correspond to grade levels at which the particular subject is addressed. Level A corresponds to grades one and two, level B to grades three and four and level C grades five and six. Each unit contains a series of lessons addressing various skills within the subject area, and each lesson contains a series of problems addressing a particular skill. The software enables students to practice basic arithmetic skills and immediately find out how well they are doing. The program also offers tutorial instruction that students can request as they need it. Students automatically move from lesson to lesson on the basis of performance. Students who score 80% or better on a lesson move ahead. Students who score 50% or less are given another chance; a second failure results in movement to a previous lesson or, in some cases, to a request to "see your teacher." Scores between 50 and 80% lead to repetition of the lesson. The program also includes a practice mode in which work is recorded but does not affect a student's standing. Teachers assign students to the placement, progress or practice modes.

The students at Periwinkle started using the WICAT System on March 12, 1984. Students continued work through June 1, 1984 and began again on September 10, 1984. This evaluation tracks growth through March 1, 1985. This would be 163 student days with approximately 10 days during that period in which the system was not available for use due to down-time or equipment or software modifications. Students are in the computer lab for two 25-minute sessions one week and three 25-minute sessions the next. Averaging the two weeks, each student spends about 62 minutes per week on the system.

The Albany School District is currently using the Real Math curriculum by Open Court Publishing Company in the elementary grades (k-5). The WICAT math curriculum provides a correlation with the Real Math curriculum as well as other publishers' materials. The teachers have found the WICAT math curriculum an excellent addition to Real Math because it provides extra drill and practice. When new skills are introduced in the classroom the WICAT curriculum is integrated at that point for drill and practice. The terminology used in Real Math is very helpful when students re-group in addition and subtraction. Also the use of finger sets and add-on counting helps with the WICAT basic addition and subtraction. The WICAT math curriculum provides drill and practice in seven curriculum areas. In addition to the drill and practice, the students may access the tutorial help sequence in most of the lessons.

Students who have progressed beyond the fifth grade level in their math skills are allowed to progress into the sixth through eighth grade curriculum. This provides bright students an added challenge that the Real Math text does not have. The curriculum also provides extra practice for remedial students who can work daily and need extra work.

Minimal keyboard training was required for the students to use the system. Students are required to type their sign-in names when beginning a lesson. After the signing-in, they need only to use the numbers on the 10-key pad, the space bar and the return, delete, escape, right and left arrow keys. In addition, to access the help sequence students need to be able to type a question mark. Prior to going to the computer lab, paper keyboards were used in the classroom to familiarize students with the necessary keys.

The lab manager, an aide, is responsible for the actual operation of the computer. The manager enters basic student data into the system, assigns students to different curriculum levels as directed by the teacher, obtains printouts of student progress for each teacher, makes a daily tape back-up of the hard disk information, and brings-up each teacher's class as they come to the lab. The lab manager is also available while students are in the lab to answer questions and to assist the teacher. The lab manager was trained for a week at WICAT headquarters in Provo, Utah. This training included use and operation of the computer, the administrative functions for student record keeping and a general knowledge to the student curriculum.

Teachers, who are knowledgeable about the Real Math and WICAT curriculums, assign students into different areas, monitor student progress via computer printouts and help students with questions while in the lab. They were trained for a day and a half in Albany by three WICAT staff. The teachers then had a week to explore the system prior to students going to the computer lab for the first time. Follow-up training by WICAT staff has occurred on a periodic basis since the initial training last spring.

III. EVALUATION DESIGN

This section outlines the evaluation activities that were planned and conducted to examine changes in student achievement, student attitude, staff attitude and parent attitude that are associated with the introduction of computer assisted instruction in a target elementary school, specifically the WICAT System 300. The evaluation design described below was implemented because of the presence of the WICAT system. It provides for a description of student performance that Periwinkle teachers get from their math program. That math program, however, consists of regular instruction using the Real Math curriculum in the classroom and WICAT computer assisted instruction in the lab. The design cannot demonstrate a casual relationship between the WICAT system and observed changes in student achievement levels and in student attitudes. Results must be generally attributed to the total math program, but some considerations may permit them to be associated to or linked with the WICAT system.

STUDENT ACHIEVEMENT

The Comprehensive Tests of Basic Skills (CTBS/U) battery was used to assess student achievement. It provided basic achievement measures in reading, language arts, mathematics, reference skills, science and social studies. CTBS/U scores were reported in NCEs or "normal curve equivalents." NCEs, ranging from 1 through 99, share some characteristics with percentile ranks. NCEs, for example, coincide with percentile ranks at 1, 50 and 99. However, they have an added advantage of being based on an equal interval scale, which allowed meaningful comparison between the different tests within the CTBS/U battery.

In February-March of 1984, all target school students in the 1st through 5th grades took the CTBS/U. Teachers, with little direction other than that provided by the examiner's manual, administered the CTBS/U in their classrooms. Similar testing was conducted at the target school in 1985. The district regularly tests 3rd and 5th grade students with the CTBS/U in late February and early March. Testing in the target school was scheduled to coincide with the annual district-wide program so that additional testing of 3rd and 5th grade students would not be required. Since empirical CTBS/U norms were established only for fall and spring of the school year, pre-post NCE data in this report were based on statistically interpolated norms.

CTBS/U data were available for four grade-level groups of students in the target school. Students were included in one of these groups only if they were present for both the pretest and the posttest. Group 1-2, for example, took the CTBS/U pretest in 1984 as 1st graders and the posttest in 1985 as 2nd graders. Similarly, between the pretest and the posttest Group 2-3 moved from the 2nd to the 3rd grade, Group 3-4 moved from the 3rd to 4th grade, and Group 4-5 moved from the 4th to 5th grade. Between pretest and posttest each grade-level group of students received instruction from five or six different teachers. For example, three 1st grade teachers and three 2nd grade teachers worked in various combinations with students in Group 1-2.

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The examination of pre-post CTBS/U achievement data addressed three questions:

1) Was there a change in the relative achievement levels among target school students when compared to the CTBS/U norm? Since NCEs indicate achievement status relative to the norm, changes in pre-post mean NCEs represent shifts of group status relative to the norm. To determine if pre-post achievement improved when compared to the norm, a two-tailed t test on repeated measures was applied to each of the CTBS/U tests for which pre-post data were available.

2) Was the achievement of target students in mathematics (active WICAT subject) greater than expected when compared to their achievement in non-WICAT subjects? To determine this, a simple linear regression of mean posttest scores on mean pretest scores was conducted for each of the four grade-level groups of target students. Achievement in a particular subject was considered "greater than expected" when its obtained mean posttest score was at least one standard error of estimate above its predicted mean score.

3) Was there a significant difference between the number of boys and the number of girls in the target school whose pre-post scores in mathematics (active WICAT subject) either improved or dropped? To determine this, Chi Square values with correction for continuity were computed for each grade-level group of target students from 2x2 contingency tables with change in performance (improvement vs. drop) and sex of student (boy vs. girl) as variables. Students whose pre-post scores showed no change were excluded from the analyses.

STUDENT ATTITUDE

A district developed Student Attitude Survey (SAS), a five-step Likert-type scale with a "smiling/frowning face and yes/no" response format suitable for young children, was used to assess student attitudes. The SAS produced composite attitude measures to three general areas in the school: curriculum (academic), climate and computers. The Student Attitude Survey is shown in Appendix A.

In Spring 1984, and again in Spring 1985, the Student Attitude Survey was administered to students in two schools, the target school and a comparison school. The comparison school as essentially self-selected; it was a close second in the competition for placement of the district's first WICAT system. The two schools were similar in size, in composition of staff and student body, and in general curriculum offerings.

The district's supervisor of program evaluation visited classrooms in both schools to administer the Student Attitude Survey, for both pretest and posttest. This enhanced the quality of the attitude data by assuring a uniform administration procedure and by reducing "immediate" teacher influence on student responses. As the SAS was given, at their own discretion, classroom teachers either left the room or moved to a quiet, work area within the room.

Student Attitude Survey data were available for four grade-level groups of students both in the target school and in the comparison school. Students were included in one of these groups only if they were present for both the pretest and the posttest. Group 1-2, for example, took the SAS pretest in 1984 as 1st graders and the posttest in 1985 as 2nd graders. Similarly, between the pretest and the posttest Group 2-3 moved from the 2nd to the 3rd grade, Group 3-4 moved from the 3rd to 4th grade, and Group 4-5 moved from the 4th to 5th grade.

The examination of pre-post Student Attitude Survey data addressed three questions:

1) Was there a change of attitudes among target school students on the SAS composites (academic, climate and computer) during the first year of WICAT operation? To determine if student attitudes had changed, a two-tailed t test on repeated measures was applied to pre-post mean ratings generated by each of the four student grade-level groups.

2) Was the attitude of target students toward mathematics (active WICAT subject) greater than expected when compared to their attitudes toward non-WICAT subjects? To determine this, a simple linear regression of mean posttest ratings on mean pretest ratings was conducted for each of the four grade-level groups of target students. A student rating of a particular subject was considered "greater than expected" when its obtained mean posttest rating was at least one standard error of estimate above its predicted mean rating.

3) Was there a significant difference between the number of target students and the number of comparison students whose pre-post composite ratings on the Student Attitude Survey either improved or dropped? To determine this, Chi Square with correction for continuity values were calculated for each grade-level group from 2x2 contingency tables with school (target vs. comparison) and change in attitude (improvements vs. drop) as variables. Students whose pre-post scores showed no change were excluded from the analyses.

STAFF ATTITUDE

A district developed "Staff Survey: Computer Assisted Instruction," a 7-step semantic differential with 21 adjective pairs, was used to assess staff attitudes. The 7-step scale, defined by linguistic qualifiers "extremely," "quite," and "slightly," in both directions from "neutral" yields nearly equal psychological units in the process of judgement. The survey produced four staff attitude profiles: a 21-item general CAI profile, a 5-item importance of CAI subprofile, a 5-item productivity of CAI subprofile, and a 5-item staff comfort with using CAI subprofile. The "Staff Survey: Computer Assisted Instruction" is shown in Appendix B.

The following adjective pairs describing computer assisted instruction made up the three staff subprofiles:

Importance Profile	Productivity Profile	Staff Comfort Profile
Important-Unimportant	Productive-Unproductive	Familiar-Unknown
Essential-Frill	Efficient-Inefficient	Easygoing-Frustrating
Necessary-Unnecessary	Expanding-Limiting	Understandable-Puzzling
Useful-Useless	Effective-Ineffective	Clear-Confusing
Valuable-Worthless	Time Saving-Consuming	Simple-Complicated

In Spring 1984 and in Spring 1985, the target school staff anonymously completed the semantic differential during a regularly scheduled faculty meeting.

Mean ratings on the pre-post administrations of the staff survey formed profile patterns of staff attitudes about computer assisted instruction. The "sign test of the profile pattern" was used to determine if the staff attitude profiles changed significantly during the first year of WICAT operation. The one-tailed sign test was applied to the general CAI profile and to each of the three CAI subprofiles.

PARENT ATTITUDE

A district developed "Parent Survey: Computer Assisted Instruction," a 7-step semantic differential with 15 adjective pairs, was used to assess parent attitudes. The 7-step scale, defined by linguistic qualifiers "extremely," "quite," and "slightly," in both directions from "neutral" yields nearly equal psychological units in the process of judgement. The survey produced three parent attitude profiles: a 15-item general CAI profile, a 5-item importance of CAI subprofile, and a 5-item productivity of CAI subprofile. The "Parent Survey: Computer Assisted Instruction" is shown in Appendix C.

The following adjective pairs describing computer assisted instruction made up the two parent subprofiles:

Importance Profile	Productivity Profile
Important-Unimportant	Productive-Unproductive
Essential-Frill	Efficient-Inefficient
Necessary-Unnecessary	Expanding-Limiting
Useful-Useless	Effective-Ineffective
Valuable-Worthless	Time Saving-Consuming

In Spring 1984, parents of target school students in the 1st through 4th grades anonymously completed the CAI survey. In Spring 1985, parents of target school students in the 2nd through 5th grades completed the survey a second time. Thus, essentially one set of parents provided pre-post data.

Mean ratings on the pre-post administrations of the parent survey formed profile patterns of parent attitudes about computer assisted instruction. The "sign test of the profile pactern" was used to determine if these parent attitude profiles changed significantly during the first year of WICAT operation. The one-tailed sign test was applied to the general CAI profile and to both of the CAI subprofiles.

IV. RESULTS

This section presents the results from the evaluation activities that were planned and conducted to examine changes in student achievement, student attitude, staff attitude and parent attitude that are associated with the introduction of computer assisted instruction in an elementary school, specifically the WICAT System 300.

STUDENT ACHIEVEMENT

Student achievement results of target school students are displayed on Table 1 (t test, change in pre-post mean scores), Table 2 (regression, obtained vs. predicted posttest scores) and Table 3 (Chi Square, achievement differences between boys and girls).

The t-test. Achievement scores for students in the target school who were present for both the 1984 and 1985 administrations of the Comprehensive Tests of Basic Skills (CTBS/U) are listed on Table 1. A two-tailed, repeated measures t-test was computed on the difference between the pre-post mean NCE scores available for each grade-level group. Since NCEs indicate status relative to a norm, observed changes in mean NCEs represent shifts of grade-level group status relative to the norm. The data on Table 1 support the following statements:

1) Student achievement in both math computation and math total increased significantly in three of the four target grade-level groups.

2) Group 1-2 experienced the most dramatic increase in math achievement. Between the 1984 pretest and the 1985 posttest, its mean score on math computation increased 15.4 NCEs, from 55.0 to 70.3. (While not heeding strict statistical requirements, some might declare this to be a 28% increase in achievement.)

3) Group 2-3 dropped in math computation and math total, but neither decrease was statistically significant.

4) Group 3-4 and Group 4-5 had significant increases in both math computation and math total, but under different environments. In Group 3-4, the significant increases in math computation and math total complemented the group's significant increase on the total battery. In Group 4-5, however, the significant increases in math computation and math total contradicted the group's significant drop on the total battery.

5) Target student achievement in math concepts and applications was up in two grade-level groups and down in two groups, but none of the pretest-posttest differences was statistically significant.

Regression. Results of the regression analyses on mean pretest-posttest CTBS/U scores of target school students are listed on Table 2. A simple linear regression of mean posttest scores on mean pretest scores was conducted for the three grade-level groups with 10 or more paired subtest-scores (Group 2-3, Group 3-4, Group 4-5). Using regression techniques to predict posttest

	Group 1-2				Group 2-3				Group 3-4				Group 4-5			
	1984	1985	Change	t/df=40	1984	1985	Change	t/df=31	1984	1985	Change	t/df=44	1984	1985	Change	t/df=52
1. Word Attack	60.3	62.1	1.7	0.84	62.1	60.7	-1.5	-0.50								
2. Read Vocab	64.1	64.0	-0.1	-0.02	65.3	59.2	-6.1	-2.84**	53.8	61.2	7.4	3.85**	64.5	64.5	-0.1	-0.04
3. Read Compr	57.9	66.0	8.0	2.55*	64.1	61.4	-2.7	-0.80	56.2	66.0	9.8	5.44**	64.6	62.9	-1.7	-1.27
4. Read Total	60.6	66.3	5.7	2.24*	65.6	61.4	-4.2	-1.99	56.0	65.4	9.4	5.79**	66.4	63.3	-3.1	-2.45*
5. Spelling					56.8	57.7	0.9	0.31	53.4	53.6	0.2	0.11	54.9	57.1	2.2	1.26
6. Lang Mech					55.4	55.8	0.4	0.16	49.4	52.1	2.8	1.16	58.1	55.8	-2.3	-1.23
7. Lang Expr	70.2	60.4	-9.8	-4.09**	62.0	66.1	4.1	1.50	58.9	66.7	7.7	4.24**	65.3	60.5	-4.8	-3.48**
8. Lang Total					60.5	65.9	5.4	2.02	57.2	59.9	2.7	1.44	62.0	58.6	-3.5	-2.59*
9. Math Comp	55.0	70.3	15.4	5.31**	66.5	62.2	-4.3	-1.30	55.8	64.3	8.4	3.72**	60.3	65.7	5.4	2.31*
10. Math C/A	64.6	61.1	-3.5	-1.99	61.0	61.1	0.1	0.04	55.4	59.3	3.9	1.99	62.2	62.0	-0.2	-0.13
11. Math Total	59.2	69.4	10.2	4.18**	67.5	63.8	-3.7	-1.29	56.4	61.3	4.8	2.67*	61.2	64.9	3.8	2.20*
12. Total Battery					63.5	66.3	2.8	1.36	57.9	63.3	5.4	3.55**	65.1	61.7	-3.4	-3.27**
13. Ref Skills													61.7	62.5	0.8	0.46
14. Science													65.6	61.8	-3.7	-2.43*
15. Soc Studies													65.7	61.5	-4.2	-2.02

* $p < .05$ ** $p < .01$

TABLE 1. REPEATED MEASURES T TEST ON THE CHANGE IN NCE MEAN ACHIEVEMENT SCORES OF FOUR GRADE-LEVEL GROUPS IN THE TARGET SCHOOL ON 1984 PRETEST AND 1985 POSTTEST ADMINISTRATIONS OF THE "COMPREHENSIVE TESTS OF BASIC SKILLS" (CTBS/U).

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	Group 2-3				Group 3-4				Group 4-5			
	X VAL	Y VAL	Y'	Y-Y'	X VAL	Y VAL	Y'	Y-Y'	X VAL	Y VAL	Y'	Y-Y'
Word Attack	62.1	60.7	61.62	-0.92								
Reading Vocab	65.3	59.2	62.97	-3.78*	53.8	61.2	58.65	2.54	64.5	64.5	62.38	2.11
Reading Comp	64.1	61.4	62.46	-1.06	56.2	66.0	62.25	3.75*	64.6	62.9	62.43	0.47
Reading Total	65.6	61.4	63.09	-1.69	56.0	65.4	61.95	3.45*	66.4	63.3	63.18	0.11
Spelling	56.8	57.7	59.38	-1.69	53.4	53.6	58.05	-4.46*	54.9	57.1	58.36	-1.27
Language Mech	55.4	55.8	58.78	-2.98*	49.4	52.1	52.04	0.05	58.1	55.8	59.70	-3.91*
Language Expr	62.0	66.1	61.57	4.52*	58.9	66.7	66.31	0.38	65.3	60.5	62.72	-2.23
Language Total	60.5	65.9	60.94	4.96*	57.2	59.9	63.75	-3.85*	62.0	58.6	61.34	-2.75*
Math Comp	66.5	62.2	63.47	-1.28	55.8	64.3	61.65	2.65	60.3	65.7	60.62	5.07*
Math C/Ap	61.0	61.1	61.15	-0.06	55.4	59.3	61.05	-1.75	62.2	62.0	61.42	0.58
Math Total	67.5	63.8	63.90	-0.11	56.4	61.3	62.55	-1.25	61.2	64.9	61.00	3.90*
Total Battery	63.5	66.3	62.21	4.09*	57.9	63.3	64.80	-1.51	65.1	61.7	62.64	-0.94
Ref Skills									61.7	62.5	61.21	1.29
Science									65.6	61.8	62.85	-1.05
Soc Studies									65.7	61.5	62.89	-1.39
Regression Equation	$Y' = 61.8 + .42(X - 62.52)$				$Y' = 61.19 + 1.5(X - 55.49)$				$Y' = 61.62 + .41(X - 62.68)$			
Standard Error of Estimate	$S_{est} = 2.80$				$S_{est} = 2.71$				$S_{est} = 2.40$			

* More than one standard error of estimate

TABLE 2. OBSERVED VS. PREDICTED POSTTEST ACHIEVEMENT OF THREE GRADE-LEVEL GROUPS IN THE TARGET SCHOOL ON THE "COMPREHENSIVE TESTS OF BASIC SKILLS" (CTBS/U) USING A SIMPLE LINEAR REGRESSION OF OBSERVED 1985 POSTTEST NCE MEANS (Y) ON 1984 PRETEST MEANS (X) TO PREDICT MEAN POSTTEST ACHIEVEMENT (Y').

	Group 1-2					Group 2-3					Group 3-4					Group 4-5				
	--Boys--		--Girls--		ChiSq	--Boys--		--Girls--		ChiSq	--Boys--		--Girls--		ChiSq	--Boys--		--Girls--		ChiSq
	UP	DN	UP	DN	df=1	UP	DN	UP	DN	df=1	UP	DN	UP	DN	df=1	UP	DN	UP	DN	df=1
Word Attack	11	10	10	8	0.02	9	10	7	6	0.00										
Reading Vocabulary	9	13	11	7	0.91	7	12	1	12		16	7	14	8	0.01	19	12	7	14	2.88
Reading Comprehension	10	12	13	6	1.35	7	12	7	6	0.35	19	4	18	4		12	17	7	11	0.02
Reading Total	12	10	13	6	0.34	6	11	4	9		17	5	18	4		12	18	8	13	0.02
Spelling						11	8	7	6	0.02	16	7	10	12	1.78	16	16	11	10	0.01
Language Mechanics						11	7	5	8	0.78	11	11	14	7	0.64	14	16	8	11	0.00
Language Expression	4	18	6	12		13	6	6	6	0.42	16	7	15	4		6	26	10	10	4.27*
Language Total						13	6	6	6	0.42	12	10	14	8	0.09	10	21	9	12	0.24
Math Computation	17	5	15	2		10	9	4	8		15	8	15	7	0.01	21	11	10	9	0.39
Math C/A	8	14	7	12	0.09	9	10	7	6	0.00	11	12	11	11	0.02	17	15	9	11	0.08
Math Total	16	6	16	3		9	10	3	10		13	9	13	9	0.09	19	12	10	9	0.09
Total Battery						11	8	6	6	0.00	15	7	14	7	0.05	10	21	5	15	0.06
Reference Skills																17	11	8	9	0.34
Science																11	18	10	10	0.30
Social Studies																9	19	7	14	0.05
	(n=22)		(n=19)			(n=19)		(n=13)			(n=23)		(n=22)			(n=32)		(n=21)		

* $p < .05$

TABLE 3. CHI SQUARE ON THE FREQUENCY OF BOYS AND GIRLS IN FOUR GRADE-LEVEL GROUPS IN THE TARGET SCHOOL WHOSE NCE SCORES ON THE "COMPREHENSIVE TESTS OF BASIC SKILLS" (CTBS/U) EITHER INCREASED OR DROPPED BETWEEN THE 1984 PRETEST AND 1985 POSTTEST.

achievement on the basis of pretest achievement identified CTBS/U subtests on which student achievement was greater or less than expected, or more specifically, beyond one standard error of estimate above or below the predicted value. The data on Table 2 support the following statements:

1) One of the three target grade-level groups exceeded its predicted performance in math, while no group fell short of its predicted performance in math.

2) Each grade-level group performed better than predicted in a different skill area. Group 2-3 excelled in language expression and language total, Group 3-4 in reading comprehension and reading total, and Group 4-5 in math computation and math total.

3) Group 2-3 lagged behind its predicted achievement level in reading vocabulary and language mechanics, Group 3-4 in spelling and language total, and Group 4-5 in language mechanics and language total.

Chi Square. Results of Chi Square analyses on the frequency of boys and girls in the target school whose CTBS/U scores either improved or dropped are listed on Table 3. Chi Square values were computed from 2x2 contingency tables with change in performance (up/down) and sex of student (boy/girl) as variables. Chi Square was not computed when any cell on a contingency table had fewer than five students. Students with identical pretest and posttest scores were not included in the analyses. The data on Table 3 support the following statements:

1) The only instance in the target school where a significant association between the change in achievement level and the sex of student was in language expression for Group 4-5. Boys in Group 4-5 dropped in language expression achievement between pretest and posttest while girls maintained their achievement level.

2) In math computation, 63% (107/171) of the students in the target school had a higher posttest score than pretest score while 34% (59) slipped lower on the posttest. Also in math computation, 66% (63/96) of the boys and 59% (44/75) of the girls had higher posttest scores than pretest scores while 34% (33) of the boys and 35% (26) of the girls slipped lower on the posttest. Chance expectation is that an equal number or percentage of student scores would gain and slip.

Further percentage breakdowns in the target school for increases and drops in math computation between pretest and posttest include:

	--Boys--		--Girls--		--Total--	
Group	UP%	DN%	UP%	DN%	UP%	DN%
1-2	77	23	79	11	78	17
2-3	53	47	31	62	44	53
3-4	65	35	68	32	67	33
4-5	66	34	48	43	58	38

The only grade-level group in the target school that did not register significant improvement in math computation, Group 2-3, is also the only group in which the percentage of girls with lower posttest scores exceeded the percentage of girls with higher pretest scores.

STUDENT ATTITUDE

Student attitude results of target school students are displayed on Table 4 (t test, change in pre-post mean ratings) and Table 5 (regression, obtained vs. predicted posttest ratings). Table 6 shows Chi Square results on attitude differences between target vs. comparison students.

The t-test. Composite attitude ratings (academic, climate and computer) of students in the target school who were present for the 1984 and 1985 administrations of the Student Attitude Survey (SAS) are listed on Table 4. A two-tailed, repeated measures t test was computed on the difference between the pre-post mean ratings for each grade-level group. The data on Table 4 support the following statements:

1) Group 1-2 had no significant pre-post changes in mean ratings on any of the SAS composites, neither academic, climate nor computer.

2) Group 2-3 had a significant decrease in the SAS computer composite, but not in the academic or climate composites. Significant pre-post drops in three computer factors (computer face, computer is easy to use, and computer makes learning more fun) contributed to the lower computer composite rating.

3) Group 3-4 had a significant decrease in the SAS academic composite, but not in the climate or computer composites. Significant pre-post rating drops in two curriculum areas (language arts and music) contributed to the lower academic composite rating.

4) Group 4-5 had no significant changes in pre-post mean ratings on any of the SAS composites, neither academic, climate nor computer.

Regression. Results of the regression analyses on mean Student Attitude Survey scores of target school students are listed on Table 5. A simple linear regression of mean posttest scores on mean pretest scores was conducted with nine curriculum areas and the academic composite providing 10 paired scores. Using regression techniques to predict posttest ratings on the basis of pretest ratings identified curriculum areas on which student observed ratings were greater or less than expected, or more specifically, beyond one standard error of estimate above or below the predicted value. The data on Table 5 support the following statements:

1) One of the four target grade-level groups (Group 3-4) exceeded its predicted mean rating of mathematics, while one group (Group 1-2) fell short of its predicted rating in math. In Group 2-3 and Group 4-5 posttest ratings of mathematics were about as predicted.

2) In the target primary grades (Group 1-2 and Group 2-3) student posttest ratings exceeded expectation for PE and art, while in the intermediate grades

	Group 1-2				Group 2-3				Group 3-4				Group 4-5			
	1984	1985	Change	t/df=39	1984	1985	Change	t/df=37	1984	1985	Change	t/df=37	1984	1985	Change	t/df=43
Art	4.35	4.93	0.58	3.10**	4.89	4.89	0.00	0.00	4.87	4.74	-0.13	-1.22	4.80	4.48	-0.32	-1.68
Health	3.95	3.53	-0.42	-1.51	3.24	2.79	-0.45	-1.59	3.76	3.32	-0.45	-1.86	2.61	2.73	0.11	0.48
Language Arts	3.65	3.78	0.13	0.46	3.63	3.47	-0.16	-0.45	3.63	2.95	-0.68	-2.56*	2.59	3.11	0.52	2.02
Mathematics	3.58	2.78	-0.80	-2.58*	3.42	3.39	-0.03	-0.11	3.66	3.71	0.05	0.24	3.34	3.30	-0.05	-0.22
Music	4.07	3.60	-0.47	-1.92	4.11	3.71	-0.39	-1.38	4.00	3.11	-0.89	-3.76**	3.59	3.43	-0.16	-0.63
PE	3.33	4.83	1.50	5.45**	3.63	4.82	1.18	4.91**	4.82	4.53	-0.29	-1.64	4.57	4.41	-0.16	-1.02
Reading	3.73	3.35	-0.38	-1.60	3.58	3.50	-0.08	-0.31	3.53	3.58	0.05	0.21	3.41	3.05	-0.36	-1.27
Science	4.05	4.03	-0.03	-0.13	3.39	2.89	-0.50	-2.16*	3.50	3.50	0.00	0.00	3.16	3.66	0.50	2.26*
Social Studies	3.50	3.18	-0.33	-1.38	2.97	2.87	-0.11	-0.37	2.92	2.76	-0.16	-0.51	2.50	3.07	0.57	2.37*
Recess	4.73	4.88	0.15	1.14	4.55	4.55	0.00	0.00	4.79	4.63	-0.16	-0.95	4.80	4.82	0.02	0.17
School Face	4.30	3.73	-0.58	-2.76**	4.21	3.55	-0.66	-2.59*	4.08	3.95	-0.13	-0.96	3.39	3.43	0.05	0.24
Like School Work	3.70	3.48	-0.23	-0.74	3.03	3.71	0.68	2.47*	3.92	3.95	0.03	0.13	3.11	3.41	0.30	1.36
Nice Things	3.88	4.18	0.30	1.03	4.29	4.47	0.18	0.76	4.42	4.37	-0.11	-0.73	3.95	3.91	-0.05	-0.22
Kids Like School	3.75	4.03	0.28	1.08	4.45	4.32	-0.13	-0.74	4.29	4.24	-0.05	-0.24	3.45	3.75	0.30	1.83
Computer Face	4.70	3.95	-0.75	-3.36**	4.76	4.29	-0.47	-2.23*	4.71	4.42	-0.29	-1.64	4.89	4.66	-0.23	-1.81
Easy To Use	4.05	4.03	-0.03	-0.13	3.39	2.89	-0.50	-2.16*	3.50	3.50	0.00	0.00	3.16	3.66	0.50	2.26*
Computer Not Scary	4.55	4.85	0.30	1.52	4.87	4.95	0.08	1.00	4.76	4.71	-0.05	-0.30	4.48	4.93	0.45	2.83**
Learning More Fun	4.63	4.07	-0.55	-1.94	4.87	4.39	-0.47	-2.69*	4.84	4.68	-0.16	-0.97	4.64	4.45	-0.18	-1.03
Learning Easier	3.88	4.18	0.30	1.03	4.29	4.47	0.18	0.76	4.47	4.37	-0.11	-0.73	3.95	3.91	-0.05	-0.22
ACADEMIC COMPOSITE	3.80	3.77	-0.03	-0.21	3.65	3.59	-0.06	-0.49	3.85	3.58	-0.28	-2.44*	3.40	3.47	0.07	0.74
CLIMATE COMPOSITE	4.07	4.06	-0.01	-0.10	4.11	4.12	0.02	0.12	4.31	4.23	-0.08	-0.84	3.74	3.86	0.12	1.30
COMPUTER COMPOSITE	4.36	4.21	-0.15	-1.07	4.44	4.20	-0.24	-2.38*	4.46	4.34	-0.12	-1.37	4.22	4.32	0.10	1.11

* $p < .05$ ** $p < .01$

TABLE 4. REPEATED MEASURES T TEST ON THE CHANGE IN MEAN RATINGS OF FOUR GRADE-LEVEL GROUPS IN THE TARGET SCHOOL ON 1984 PRETEST AND 1985 POSTTEST ADMINISTRATIONS OF THE "STUDENT ATTITUDE SURVEY."

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	Group 1-2				Group 2-3				Group 3-4				Group 4-5			
	X VAL	Y VAL	Y'	Y-Y'	X VAL	Y VAL	Y'	Y-Y'	X VAL	Y VAL	Y'	Y-Y'	X VAL	Y VAL	Y'	Y-Y'
Art	4.35	4.92	4.12	0.80*	4.89	4.09	4.93	-0.04	4.86	4.73	4.50	0.23	4.79	4.46	4.40	0.05
Health	3.95	3.52	3.86	-0.34	3.23	2.78	3.13	-0.36	3.76	3.31	3.48	-0.18	2.61	2.72	2.93	-0.22
Language Arts	3.65	3.77	3.67	0.01	3.63	3.47	3.56	-0.01	3.63	2.94	3.36	-0.42*	2.59	3.11	2.92	0.19
Mathematics	3.57	2.77	3.62	-0.85*	3.42	3.39	3.34	0.04	3.65	3.71	3.38	0.32*	3.34	3.29	3.42	-0.14
Music	4.07	3.60	3.94	-0.35	4.10	3.71	4.07	-0.37	4.00	3.10	3.70	-0.61*	3.59	3.43	3.59	-0.16
PE	3.32	4.82	3.46	1.36*	3.63	4.81	3.56	1.25*	4.81	4.52	4.46	0.05	4.56	4.40	4.24	0.16
Reading	3.72	3.35	3.72	-0.38	3.57	3.50	3.50	0.00	3.52	3.57	3.26	0.30	3.40	3.04	3.46	-0.43*
Science	4.05	4.02	3.93	0.08	3.39	2.89	3.30	-0.42	3.50	3.50	3.24	0.26	3.15	3.65	3.30	0.35*
Social Studies	3.50	3.17	3.58	-0.41	2.97	2.86	2.85	0.00	2.92	2.76	2.70	0.05	2.50	3.06	2.86	0.20
Academic Comp.	3.79	3.77	3.76	0.00	3.65	3.59	3.59	0.00	3.85	3.57	3.57	0.00	3.39	3.46	3.46	0.00
Regression Equation	$Y' = 3.77 + .63(X - 3.79)$				$Y' = 3.58 + 1.08(X - 3.64)$				$Y' = 3.57 + .92(X - 3.85)$				$Y' = 3.46 + .67(X - 3.39$			
Standard Error of Estimate	$S_{est} = .61$				$S_{est} = .44$				$S_{est} = .30$				$S_{est} = .22$			

* More than one standard error of estimate

TABLE 5. OBSERVED VS. PREDICTED POSTTEST CURRICULUM/ACADEMIC RATINGS OF FOUR GRADE-LEVEL GROUPS IN THE TARGET SCHOOL ON THE "STUDENT ATTITUDE SURVEY" USING A SIMPLE LINEAR REGRESSION OF OBSERVED 1985 POSTTEST MEANS (Y) ON 1984 PRETEST MEANS (X) TO PREDICT MEAN POSTTEST RATINGS (Y').

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	Group 1-2					Group 2-3					Group 3-4					Group 4-5				
	Target Schl UP	Target Schl DN	Compar Schl UP	Compar Schl DN	ChiSq df=1	Target Schl UP	Target Schl DN	Compar Schl UP	Compar Schl DN	ChiSq df=1	Target Schl UP	Target Schl DN	Compar Schl UP	Compar Schl DN	ChiSq df=1	Target Schl UP	Target Schl DN	Compar Schl UP	Compar Schl DN	ChiSq df=1
Art	13	2	8	4		1	4	2	8		2	6	3	9		3	10	0	5	
Health	12	18	14	13	0.40	12	19	16	13	1.04	7	18	7	14	0.00	17	12	11	11	0.1
Language Arts	17	14	14	8	0.13	11	14	14	13	0.08	9	21	11	15	0.46	21	12	16	11	0.0
Mathematics	9	21	11	10	1.74	17	16	12	14	0.02	11	11	9	19	0.98	14	14	10	15	0.2
Music	7	17	9	8	1.47	12	17	5	14	0.58	7	19	7	12	0.15	15	18	11	13	0.0
PE	20	0	8	1		21	2	3	6		3	10	7	3		7	10	2	4	
Reading	9	20	8	15	0.00	12	14	7	13	0.21	13	12	14	17	0.06	14	20	16	8	2.7
Science	10	15	15	8	2.13	9	19	11	18	0.03	14	14	16	16	0.07	23	9	13	11	1.1
Social Studies	10	16	17	11	1.85	14	12	11	15	0.31	13	17	24	6	7.05**	21	11	7	15	4.6
Recess	5	2	9	5		5	6	4	9		3	8	9	6		3	5	5	3	
School Face	3	20	6	14		6	17	6	17	0.11	8	13	9	9	0.18	9	10	11	15	0.0
Like School Work	12	16	11	13	0.00	20	8	13	10	0.66	12	10	15	13	0.05	16	13	13	11	0.0
Nice Things	17	10	11	11	0.39	13	11	4	12		7	12	8	14	0.09	14	14	8	15	0.6
Kids Like School	12	10	8	11	0.23	7	9	9	9	0.00	8	11	10	17	0.00	17	9	10	14	1.9
Computer Face	3	14	9	3		4	15	3	8		3	12	4	6		3	11	2	8	
Easy To Use	10	15	15	8	2.13	9	19	11	18	0.03	14	14	16	16	0.07	23	9	13	11	1.18
Computer Not Scary	2	9	1	5		1	5	0	3		4	4	1	4		2	11	1	3	
Learning More Fun	7	15	15	1		4	13	6	6		2	10	8	9		5	13	6	6	0.72
Learning Easier	10	17	11	11	0.39	11	13	12	4		12	7	14	8	0.09	1	14	15	8	0.6
ACADEMIC COMPOSITE	16	20	21	14	1.15	14	23	10	23	0.17	10	25	21	19	3.48	19	22	16	17	0.0
CLIMATE COMPOSITE	16	18	15	18	0.01	18	16	11	24	2.45	12	16	20	19	0.19	23	16	14	18	1.0
COMPUTER COMPOSITE	5	27	19	9	14.87**	5	26	12	15	4.30*	14	21	18	14	1.18	17	17	16	12	0.0
	(n=40)		(n=37)			(n=38)		(n=36)			(n=38)		(n=42)			(n=44)		(n=36)		

* $p < .05$ ** $p < .01$

TABLE 6. CHI SQUARE ON THE FREQUENCY OF TARGET STUDENTS AND COMPARISON STUDENTS IN FOUR GRADE-LEVEL GROUPS WHOSE RATINGS ON THE "STUDENT ATTITUDE SURVEY" EITHER INCREASED OR DROPPED BETWEEN THE 1984 PRETEST AND 1985 POSTTEST.

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student posttest ratings of mathematics (Group 3-4) and science (Group 4-5) were higher than predicted.

3) Target school subjects with ratings lower than predicted include math (Group 1-2), language arts and music (Group 3-4), and reading (Group 4-5). Group 2-3 had no subject rating below its predicted level.

Chi Square. Results of Chi Square analyses on the frequency of target students and comparison students whose composite ratings on the Student Attitude Survey either improved or dropped are listed on Table 6. Chi Square values with correction for continuity were calculated from 2x2 contingency tables with change in pre-post rating (up vs. down) and school (target vs. comparison) as variables. Chi Square was not computed when any cell on a contingency table had fewer than five students. Students with identical pretest and posttest ratings were not included in the analyses. The data on Table 6 support the following statements:

1) There was no significant difference in the frequency of target and comparison students whose pre-post academic composite ratings either gained or slipped for any of the four grade-level groups.
2) There was no significant difference in the frequency of target and comparison students whose pre-post climate composite ratings either gained or slipped for any of the four grade-level groups.

3) There were significant differences between target students and comparison students in frequency of change in computer composite ratings in Group 1-2 and Group 2-3, both favoring the comparison students. In Group 1-2, more target students gave a lower posttest rating than a higher rating while more comparison students gave a higher posttest rating than a lower rating. In Group 2-3, both target and comparison students gave more lower than higher posttest ratings, but the drop was greater among target students.

4) There was no significant difference in the frequency of target and comparison students whose pre-post computer composite ratings either gained or slipped for Group 3-4 or Group 4-5.

STAFF ATTITUDE

Staff profiles and mean ratings from the pre-post administrations of the 21-item, 7-step semantic differential about computer assisted instruction are presented on Table 7. The 21-item general CAI profile included three 5-item subprofiles: Importance of CAI, Productivity of CAI, and Staff comfort with using CAI. A one-tail sign test of profile pattern was applied to the four profiles to determine if staff attitudes changed significantly during the first year of WICAT operation. The probability that with fewer than five exceptions the posttest means would fall consistently to either side of the pretest means is less than .05 for the general profile. The probability that all posttest means would fall to either side of the pretest means is less than .05 for the subprofiles. The data on Table 7 support the following statements:

Periwinkle Staff CAI Profiles

Key: 1984 (n=22) ------- 1985 (n=22) ———

	Average Rating			Standard Deviation		
	1984	1985	DIFF.		1984	1985
1.	5.27	4.77	-0.50	1.	1.70	1.48
2.	4.64	3.64	-1.00	2.	1.40	1.59
3.	5.00	4.23	-0.77	3.	1.60	1.51
4.	6.18	5.45	-0.73	4.	.96	1.26
5.	5.95	5.18	-0.77	5.	1.13	1.14
6.	5.91	5.36	-0.55	6.	1.19	.95
7.	5.73	5.27	-0.46	7.	1.03	1.28
8.	5.86	4.55	-1.31	8.	.99	1.74
9.	5.50	4.95	-0.55	9.	1.06	1.36
10.	5.09	4.32	-0.77	10.	1.54	1.67
11.	4.18	5.68	+1.50	11.	1.68	1.09
12.	4.14	4.59	+0.45	12.	1.08	1.22
13.	4.91	5.64	+0.73	13.	1.34	.95
14.	4.68	5.45	+0.77	14.	1.32	.86
15.	3.91	4.23	+0.32	15.	1.31	1.02
16.	6.05	5.41	-0.64	16.	1.17	1.26
17.	5.86	4.77	-1.09	17.	1.17	1.48
18.	6.73	4.77	-1.96	18.	.55	1.41
19.	2.18	1.95	-0.23	19.	1.40	1.79
20.	3.77	3.50	-0.27	20.	1.48	2.04
21.	6.09	6.45	+0.36	21.	1.54	.80

TABLE 7. CAI PROFILES, MEAN RATINGS AND STANDARD DEVIATIONS OF TARGET SCHOOL STAFF FROM 1984 AND 1985 ADMINISTRATIONS OF THE "STAFF SURVEY: COMPUTER ASSISTED INSTRUCTION."

1) There was no significant difference between the staff's 1984 general CAI profile and its 1985 general CAI profile. Profiles from both years were typically favorable toward computer assisted instruction.

2) There was a significant difference in staff attitude between 1984 and 1985 on each of the three CAI subprofiles. The staff gave lower ratings to the importance (5.41 to 4.65) and productivity (5.62 to 4.89) of CAI after a year of experience, but felt more comfortable using computer assisted instruction (4.36 to 5.12).

3) Thirty-six (36) of the staff's 42 mean ratings were favorable toward computer assisted instruction. The staff gave two items (reasonable-expensive and required-elective) unfavorable ratings on both pretest and posttest. One item (essential-frill) noted a pre-post staff shift from slightly favorable to slightly unfavorable. On another item (simple-complicated) the staff rating changed from slightly unfavorable to slightly favorable.

4) The single largest pre-post change in staff mean rating (-1.96) was on the interesting-boring adjective pair, which went from extremely interesting to slightly interesting. The smallest pre-post change in staff mean rating (-0.23) was on the reasonable-expensive adjective pair, which went from quite expensive to extremely expensive.

PARENT ATTITUDE

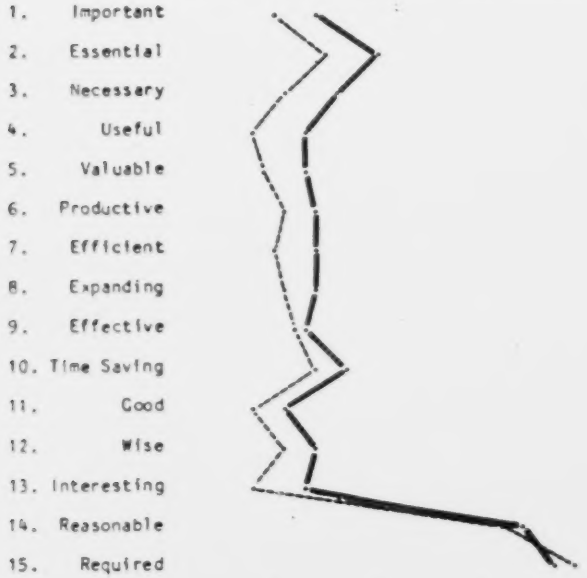
Parent profiles and mean ratings from the pre-post administrations of the 15-item, 7-step semantic differential about computer assisted instruction are presented on Table 8. The 15-item general CAI profile included two 5-item subprofiles: importance of CAI and productivity of CAI. A one-tail sign test of the profile pattern was applied to the three profiles to determine if parent attitudes changed significantly during the first year of WICAT operation. The probability that with fewer than three exceptions the 15 posttest means would fall consistently to either side of the pretest means is less than .05 for the general profile. The pretest means is less than .05 for the general profile. The probability that all posttest means would fall to either side of the pretest means is less than .05 for the subprofiles. The data on Table 8 support the following statements:

1) The 1984 parent general CAI profile was significantly different from the 1985 parent general CAI profile. Profiles from both years were typically favorable toward computer assisted instruction, but 14 of 15 posttest ratings were slightly lower than the corresponding pretest ratings.

2) There was a significant difference on both parent CAI attitude subprofiles between 1984 and 1985. Parents gave lower, but still favorable, ratings to the importance of CAI (5.94 to 5.46) and to the productivity of CAI (5.84 to 5.53) after a year of experience with the WICAT Hydra system.

3) Twenty-six (26) of the parent's 30 mean ratings were favorable toward computer assisted instruction. Parents, like the staff, gave two items (reasonable-expensive and required-elective) unfavorable ratings on both pretest and posttest.

Periwinkle Parent CAI Profiles



		Average Rating			Standard Deviation		
		1984	1985	DIFF.		1984	1985
1.	Unimportant	6.04	5.60	-0.44	1.43	1.64	
2.	Frill	5.51	4.97	-0.54	1.58	1.69	
3.	Unnecessary	5.86	5.37	-0.49	1.41	1.60	
4.	Useless	6.17	5.69	-0.48	1.19	1.61	
5.	Worthless	6.11	5.67	-0.44	1.17	1.40	
6.	Unproductive	5.92	5.56	-0.36	1.35	1.36	
7.	Inefficient	6.02	5.61	-0.41	1.34	1.55	
8.	Limiting	5.89	5.56	-0.33	1.30	1.39	
9.	Ineffective	5.82	5.66	-0.16	1.41	1.41	
10.	Time Consuming	5.56	5.28	-0.28	1.45	1.54	
11.	Bad	6.16	5.85	-0.31	1.27	1.34	
12.	Foolish	5.86	5.57	-0.29	1.40	1.42	
13.	Boring	6.23	5.74	-0.49	1.13	1.55	
14.	Expensive	3.80	3.64	-0.16	1.77	1.77	
15.	Elective	3.10	3.34	+0.24	1.80	1.91	

Key: 1984 (n=142) ——— 1985 (n=163) ———

TABLE 8. CAI PROFILES, MEAN RATINGS AND STANDARD DEVIATIONS OF TARGET SCHOOL PARENTS FROM 1984 AND 1985 ADMINISTRATIONS OF THE "PARENT SURVEY: COMPUTER ASSISTED INSTRUCTION."

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V. DISCUSSION AND CONCLUSIONS

Teachers at Periwinkle Elementary School, using the WICAT system as a tool, promoted significant gains in their students' math achievement scores on a standardized test. These gains essentially paralleled achievement gains in schools of other districts using computer assisted instruction. The staff and parents at Periwinkle typically rated computer assisted instruction as an important and productive practice at the elementary school level.

STUDENT ACHIEVEMENT

Periwinkle students in three of four grade-level groups using the WICAT system enjoyed statistically significant increases of CTBS/U scores in math computation and math total when compared to the norm group. Math total was the only "total subject" score on the CTBS/U for which all significant changes in student achievement were positive. Unlike math computation and math total, however, none of the Albany grade-level groups using WICAT marked significant change in math concepts and applications, either positive or negative. These findings about WICAT computer assisted instruction results are consistent with the results observed in the Pasco (Washington) schools with the MicroHost Instructional System, a WICAT competitor. In Pasco, students using MicroHost were up in (CTBS/U and California Achievement Tests) math computation and math total when compared to other district math programs, but not in math concepts and applications.

Math achievement increased significantly among WICAT students in three different "achievement environments." In one environment where a WICAT grade-level group experienced significant gains and drops in other CTBS/U subjects, the students had significant gains in math computation and math total. In a second environment where a WICAT grade-level group experienced several significant gains across the CTBS/U subjects including total battery, the students also had significant gains in math computation and math total. In a third environment where a WICAT grade-level group experienced several significant drops across the CTBS/U subjects including total battery, the students countered with significant drops across the CTBS/U subjects including total battery, the students countered with significant gains in math computation and math total.

Even though NCEs, percentiles and other standard test scores lack the zero value characteristic of a ratio scale that permits the computation of percentages, change in student achievement scores is often reported as a "growth percentage." For example, a junior high school in Oxnard (California) with the WICAT system reported: "We had a 10 percent growth in the area of (6th grade CTBS) math and felt it significant." Albany math computation results reported this manner compares quite favorably with the Oxnard results. The mean NCE gain of 5.4 for Group 4-5 was a 9 percent growth; the mean NCE gain of 8.4 for Group 3-4 was a 15 percent growth; and, believe it or not, the mean NCE gain of 15.4 for Group 1-2 was a 27 percent growth.

Boys and girls at Periwinkle School seemed to benefit similarly in math achievement from computer assisted instruction provided by the WICAT system. This finding disagrees with a study completed at the University of Illinois at

Chicago -- a secondary analysis of several different research efforts -- that concluded boys using computers achieve more than girls. (SchoolTechNews, February 1985, p. 1.)

In 1984 before WICAT was implemented, mean math scores for all grade-level groups at Periwinkle were above the national norm. In 1985 after one year of using WICAT, mean math scores for all grade-level groups at Periwinkle were still above the national norm, but several of those mean scores were even significantly higher than in 1984.

STUDENT ATTITUDES

Significant improvement in math achievement was not necessarily related to the students' attitude toward math. The grade-level group of students with the most dramatic gain in math achievement also exhibited a significant unfavorable change from a positive to a negative attitude toward math. None of the other grade-level groups had a significant change in attitude toward math; they maintained their positive attitudes toward math through their first of computer assisted instruction.

Attitudes of Periwinkle students toward math dropped significantly from a positive (3.58) to a negative (2.78) rating in Group 1-2, but remained essentially the same (positive) in the other three grade-level groups.

Computer composite ratings of Periwinkle Group 2-3 students dropped significantly between 1984 (4.44) and 1985 (4.20), but remained quite positive even after the drop. Changes in student attitudes toward computers, as shown by the computer composite rating, differed significantly between Periwinkle students and "comparison students" in Group 1-2 and Group 2-3, both differences in favor of the comparison students. At Periwinkle, student-computer interaction is frequent and routine, and it involved a considerable amount of the hard work of learning basic skills. At the comparison school, which has a limited number of microcomputers, student-computer interaction was relatively infrequent, and it often involved computer games and learning reinforcement activities. While students in the lower grades tended to think less of the computer after a year of WICAT experience, it should be strongly noted that the computer composite ratings of all four Periwinkle grade-level groups were quite positive in 1984 and remained quite positive in 1985.

PARENT AND STAFF ATTITUDES

Parent and staff gave favorable ratings to the importance and productivity of computer assisted instruction, both in 1984 before WICAT was operational and in 1985 after a year of experience with the system. The 2985 parent and staff surveys were conducted before the student CTBS/U achievement results were available. Ratings of WICAT productivity may have been higher if these results were available before parents and staff received the follow-up survey. In contrast to the generally favorable ratings for computer assisted instruction, both staff and parents acknowledged a concern about WICAT costs on the 1984 and 1985 surveys.

In the excitement of planning for and in implementing the use of a new, high-tech teaching tool, it is likely that some staff members developed unrealistically high expectations about what computer assisted instruction could and should accomplish in the elementary school. Apparently a year of experience with the WICAT system adjusted staff expectations to reality. Nonetheless, the experienced staff generally rated computer assisted instruction as both important and productive. The staff also reported a higher comfort level in using the program after one year of hands on experience.

The concern about WICAT costs expressed by some parents originates in a belief that computer assisted instruction should or could be delivered through a room full of smaller, "less expensive" microcomputers rather than the larger, "very expensive" minicomputer. A study conducted at Stanford University found that the cost of delivering computer assisted instruction is slightly less with more powerful minicomputers than with microcomputers, considering hardware and maintenance costs only. This "small cost advantage would be substantially greater if one were to account for all of the ingredients and their cost, especially in personnel needs." The microcomputer network "at present is complex and unpredictable enough to require substantially greater surveillance and knowledge...by the coordinator than does the minicomputer approach." (SchoolTechNews, February 1985, p. 2.)

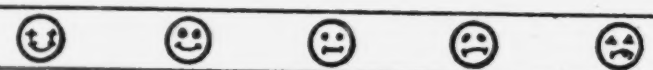
SUMMARY

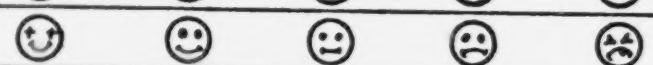
The math program at Periwinkle Elementary School consisted of regular instruction using the Real Math curriculum in the classroom and WICAT computer assisted instruction in the lab. Students, parents and staff generally gave favorable ratings to computer assisted instruction. In the first year of this program, student achievement scores in math computation and math total increased significantly, even dramatically, in three of four student grade-level groups. This improved math achievement was apparently unrelated to student attitudes toward math or computers; student math and computer attitudes vacillated while achievement scores improved. In addition, boys and girls similarly enjoyed improved math scores. Indeed, the first year of the Periwinkle math program, of which WICAT computer assisted instruction was a part, was effective. Two considerations suggest that the WICAT system is closely associated with the improved math performance. First, each of the student groups with significant math gains made those gains under a different "achievement environment." Second, the pattern of improved math scores at Periwinkle was consistent with the pattern of improved math scores reported in other schools that have used computer assisted instruction.

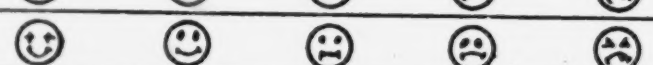
SURVEY

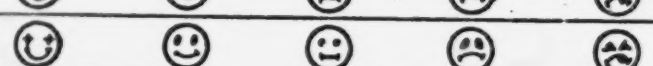
School _____ Name _____

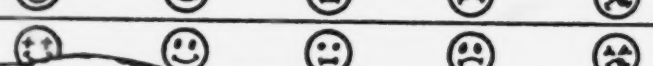
Grade _____ Date _____

AA 

BB 

1. 

2. 

3. 

STUDENT ATTITUDE SURVEY 3/85

AA What face do you wear when you are eating spinach?
BB What face do you wear when you are eating "gizwaz"?
1 What face do you wear when it's time to go to school?
2 What face do you wear when you are learning math?
3 What face do you wear when you are doing art?
4 What face do you wear when you are learning science?
5 What face do you wear when you are working on reading?
6 What face do you wear when you are doing music?
7 What face do you wear when you are at recess?
8 What face do you wear when you are doing social studies?
9 What face do you wear when you are working on a computer?
10 What face do you wear when you are learning health?
11 What face do you wear when you are at the school library?
12 What face do you wear when you are doing language arts?
13 What face do you wear when you are in PE?
CC Do you think spinach tastes good?
14 Do you think computers are easy to use?
15 Do your think kids like this school?
16 Do you think computers make learning more fun?
17 Do you like the school work that you do?
18 Do you think computers made learning easier?
19 Do you think there are a lot of nice things to do at school?
20 Do you think computers are scary?

Academic Composite: Items 2-3-4-5-6-8-10-12-13
Climate Composite: Items 1-7-15-17-19
Computer Composite: Items 9-14-16-18-20

					NO
16.	YES		MAYBE	no	NO
17.	YES	yes	MAYBE	no	NO
18.	YES	yes	MAYBE	no	NO
19.	YES	yes	MAYBE	no	NO
20.	YES	yes	MAYBE	no	NO

APPENDIX A

Staff Survey: Computer Assisted Instruction
Greater Albany Public Schools

PERIWINKLE 1985

Computer Assisted Instruction makes use of a computer to present instruction, to help teach students. Simple computer activities include rote drill and practice, with the computer serving as drill master and record keeper. Complex activities may involve dialog systems where student and computer interact in sophisticated problem solving activities.

INSTRUCTIONS. After reading the statement above, indicate how you feel about computer assisted instruction. Circle the number between each of the pairs of adjectives that best reflects your thinking right now.

COMPUTER ASSISTED INSTRUCTION

1.	good	1...2...3...4...5...6...7	bad
2.	essential	1...2...3...4...5...6...7	frill
3.	familiar	1...2...3...4...5...6...7	unknown
4.	useless	1...2...3...4...5...6...7	useful
5.	wise	1...2...3...4...5...6...7	foolish
6.	boring	1...2...3...4...5...6...7	interesting
7.	important	1...2...3...4...5...6...7	unimportant
8.	frustrating	1...2...3...4...5...6...7	easygoing
9.	necessary	1...2...3...4...5...6...7	unnecessary
10.	unproductive	1...2...3...4...5...6...7	productive
11.	simple	1...2...3...4...5...6...7	complicated
12.	expensive	1...2...3...4...5...6...7	reasonable
13.	inefficient	1...2...3...4...5...6...7	efficient
14.	expanding	1...2...3...4...5...6...7	limiting
15.	understandable	1...2...3...4...5...6...7	puzzling
16	worthless	1...2...3...4...5...6...7	valuable
17.	confusing	1...2...3...4...5...6...7	clear
18.	required	1...2...3...4...5...6...7	elective
19.	effective	1...2...3...4...5...6...7	ineffective
20.	time consuming	1...2...3...4...5...6...7	time saving
21.	I can	1...2...3...4...5...6...7	I can't

22. Comments (optional): _____

_____

_____

23. Level: ___Elementary ___Middle ___High School

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Parent Survey: Computer Assisted Instruction
Greater Albany Public Schools

PERIWINKLE 1985

Computer Assisted Instruction makes use of a computer to present instruction, to help teach students. Simple computer activities include rote drill and practice, with the computer serving as drill master and record keeper. Complex activities may involve dialog systems where student and computer interact in sophisticated problem solving activities.

INSTRUCTIONS. After reading the statement above, indicate how you feel about computer assisted instruction. A "1" or "7" on the scale shows strong feeling one way or the other; a "4" is neutral. Please circle the number between each of the adjective pairs that best reflects your opinion.

COMPUTER ASSISTED INSTRUCTION

1.	good	1...2...3...4...5...6...7	bad
2.	frill	1...2...3...4...5...6...7	essential
3.	efficient	1...2...3...4...5...6...7	inefficient
4.	foolish	1...2...3...4...5...6...7	wise
5.	important	1...2...3...4...5...6...7	unimportant
6.	expanding	1...2...3...4...5...6...7	limiting
7.	expensive	1...2...3...4...5...6...7	reasonable
8.	necessary	1...2...3...4...5...6...7	unnecessary
9.	productive	1...2...3...4...5...6...7	unproductive
10.	boring	1...2...3...4...5...6...7	interesting
11.	useful	1...2...3...4...5...6...7	useless
12	effective	1...2...3...4...5...6...7	ineffective
13.	elective	1...2...3...4...5...6...7	required
14.	valuable	1...2...3...4...5...6...7	worthless
15.	time consuming	1...2...3...4...5...6...7	time saving

16. Comments (optional): _____

_____

_____